URINARY FRACTIONAL EXCRETION OF BICARBIONATE IN HEALTHY ADULT HORSES: A POTENTIAL TOOL FOR ASSESSMENT OF RENAL TUBULAR FUNCTION?

Louise C. Lemonnier[1], R. Gaillot[2], C. Thorin[3], A.A. Leroux[4,5]

[1]MBVet – Equine Veterinary Clinic of Meheudin, Ecouché-les-Vallées, France
[2]Veterinary Clinic of la ronde, Neuillé, France
[3]Nutrition PhysioPathologie et Pharmacologie, University of Nantes, ONIRIS, Nantes, France
[4]L'Institut du Thorax, University of Nantes, CHU Nantes, CNRS, INSERM, Nantes, France
[5]ONIRIS CISCO, University Teaching Hospital, Nantes, France

INTRODUCTION

Bicarbonate (HCO_3^-) reabsorption by renal tubules is a key component of renal acid-base regulation and maintenance of systemic pH homeostasis. Oral or intravenous supplementation with HCO_3^- is indicated in the management of horses with metabolic acidosis secondary to renal loss of HCO_3^-. Dosage is calculated based on the described formula (Figure 1). However, it is the author's impression that the formula sometimes fails to anticipate relapse in such cases. Similarly to fractional excretion of other electrolytes (for example sodium and chloride), fractional excretion of HCO_3^- ($FE[HCO_3]$) could reflect renal tubular dysfunction and might allow better quantification of renal loss of HCO_3^-, and thus help in the management of these patients. However, reference values of $FE[HCO_3]$ in horses are unknown.

$$HCO_3^- \text{ dose (mmol)} = 0.3 \times \text{body weight (kg)} \times \text{base deficit}$$

Figure 1. Formula for calculation of HCO_3^- supplementation[1]

The aim of this study is to assess fractional excretion of HCO_3^- ($FE[HCO_3]$) in healthy adult horses.

MATERIALS AND METHODS

Horses from the Teaching Herd of the University Teaching Hospital of Oniris were assessed by physical examination, complete hemato-biochemical bloodwork and urinalysis. Horses were excluded if deemed unhealthy based on physical and/or laboratory findings, if they had a history of renal disease or if they had received any medication in the past month.

Twenty mares (17 French Trotters and 3 Warmbloods) were included and divided in 3 groups (n=8, n=8, n=4). Biological waste products (blood and urine) were collected during students' teaching practicals, without sedation with mares in stocks, and quickly analyzed. Serum and urinary HCO_3^- ($sHCO_3$ and $uHCO_3$, respectively) and creatinine (sCr and uCr, respectively) were measured at 3 time points (D1, D8 and D15) in order to assess time effect. $FE[HCO_3]$ was calculated according to the described formula (Figure 2).

$$FE[HCO_3] = \frac{u(HCO_3)}{s(HCO_3)} \times \frac{s(Cr)}{u(Cr)} \times 100$$

Figure 2 . Formula for the calculation of fractional excretion of bicarbonate ($FE[HCO_3]$)[2]

All statistical calculations and graphs were performed with R software (4.1.3 version). A mixed effect linear model considering random effects on horse, and Tukey's post-Hoc tests were conducted in order to assess effects of group, age and time on $FE[HCO_3]$. A value of $p<0.05$ was considered significant.

RESULTS

- 47 paired samples were collected (D1=20, D8=18, D15=9)
  (13 samples were discarded due to technical issues)
- Median age was 13.9 years (range 9-19)
- All serum creatinine and HCO_3^- values were within normal limits
  - **Mean $sHCO_3$ = 30.3 mmol/L (range 26.7-34.0)**
  - **Mean $uHCO_3$ = 197.0 mmol/L (range 17.0-344.0)**

  → Mean $FE[HCO_3]$ = 4.4% (range 0.6-9.1)
- **$FE[HCO_3]$ was significantly different between D1 and D8**
  (p=0.001, 95% CI 0.73,2.5) (Figure 3)
- **A significant effect of age on $FE[HCO_3]$ was noted at D1** but not at D8
  (p=0.01, 95% CI -0.56-0.05)
- Group had no significant effect on $FE[HCO_3]$
- Not enough samples were usable at D15 to perform statistical analysis

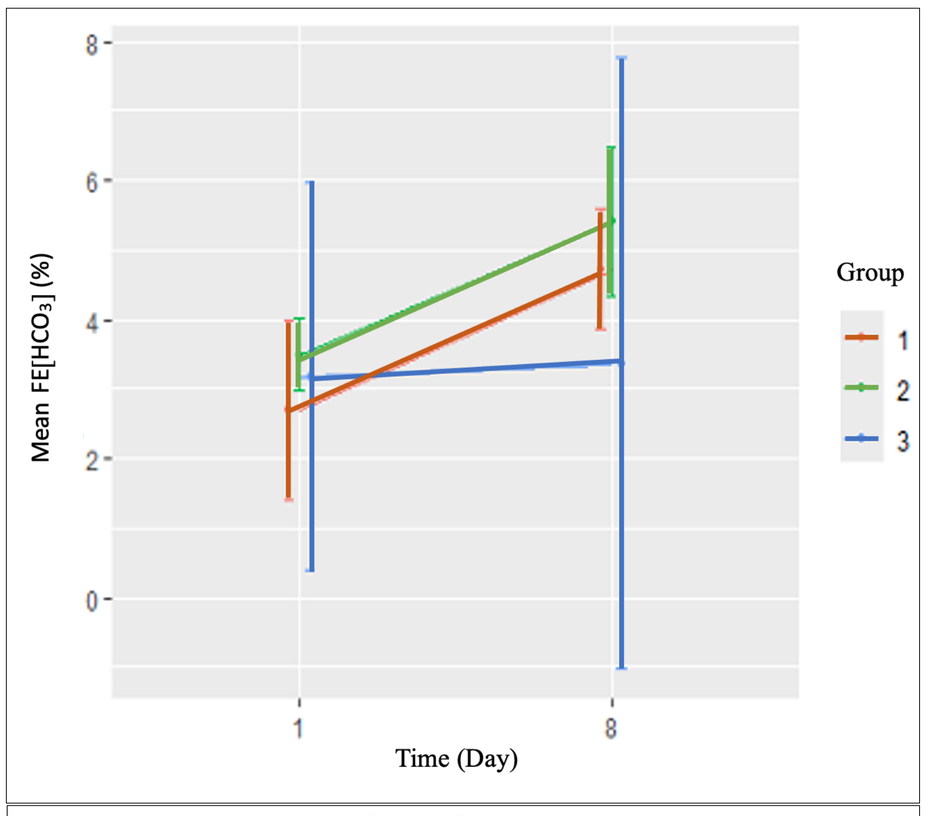

Figure 3. $FE[HCO_3]$ according to time (mean and 95% CI)

DISCUSSION AND CLINICAL RELEVANCE

A mean $FE[HCO_3]$ of 4.4% (range 0.6-9.1) was found in healthy adult horses. A significant effect of time and age but not group was observed.

Limitations to the study include its small study sample and the loss of a number of samples for statistical analysis. Only female horses, mostly French Trotters, were included.

Clinical application: $FE[HCO_3]$ was measured in 3 horses with renal disease and higher values were observed. In a horse with type-2 renal tubular acidosis (RTA-2), $FE[HCO_3]$ was 27% during acidotic crisis. This horse frequently relapses despite close monitoring and adjustment of the oral dose of $NaHCO_3$ administered. In a horse with acute kidney injury secondary to immune-mediated myositis, $FE[HCO_3]$ was 21.5%. Finally, in a horse with NSAIDs-induced acute kidney injury, $FE[HCO_3]$ was 16.3%.

CONCLUSION

This is the first study to assess $FE[HCO_3]$ in healthy adults horses.
Despite some limitations and the need for further studies, the described normal values could help clinicians in the diagnosis, monitoring and management of horses with renal tubular diseases associated with loss of HCO_3^-.

ECEIM Congress, 20th-22nd November 2025

[1]Kunchur, M.G., Mauch, T.J., Parkanzky, M. and Rahilly, L.J. (2024) A review of renal tubular acidosis. *J Vet Emergen Crit Care* 34, 325–355.
[2]Schott, H.C., Waldridge, B. and Bayly, W.M. (2018) Disorders of the Urinary System. In: *Equine Internal Medicine,* Elsevier. pp915.